SOKOLOV, O.K.; BELYAYEV, A.I.

Free energy and the mechanism of the $NaMgF_3$ complex compound formation. Izv. vys. ucheb. zav.; tsvet. met. 3 no.5:72-78 '60. (MIRA 13:11)

1. Krasnoyarskiy institut tsvetnykh metallov. Kafedra metallurgii legkikh metallov.
(Sodium magnesium fluoride—Thermal properties)

SOKOLOV, O.K.; BELYAYEV, A.I.

Interaction of magnesium and calcium fluorides in cryolite melts during "hot" titration. Izv. vys. ucheb. zav.; tsvet. met. 3 no.4: 58-64 '60. (MIRA 13:9)

1. Krasnoyarskiy institut tsvetnykh metallov. Kafedra metallurgii legkikh metallov.

(Cryolite) (Titration) (Fluorides)

S/136/60/000/04/011/025
E091/E235

Properties of Industrial Aluminium Cell Electrolytes Containing Magnesium Fluoride

V. A. Sazhina and V. N. Chechentsev assisted in the experimental work. There are 3 figures, 5 tables and 2 Soviet references.

ASSOCIATION: Institut tsvetnykh metallov (Institute of Non-Ferrous Metals)

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S/136/60/000/04/011/025
E091/E235

Properties of Industrial Aluminium Cell Electrolytes Containing Magnesium Fluoride

cryolite ratio decreases as the MgF_2 concentration increases. On increasing the MgF_2 from 3.5 to 6% the volatility of the electrolyte decreases noticeably (Fig 3). The authors arrive at the following conclusions: 1 - Electrolytes of industrial aluminium cells containing MgF_2 have a lower melting point, approximately the same density and a somewhat lower electrical conductivity and volatility than those without MgF_2; 2 - The following conditions are favourable for the application of MgF_2 as one of the constituents of industrial aluminium electrolytes: cryolite ratio = 2.5 to 2.65 and MgF_2 = 5 to 5.5%. Such an electrolyte crystallises at 930 to 935°C (i.e. 30 to 35°C below the melting point of a similar electrolyte without MgF_2); it has a density of 2.090 to 2.036 g/cm^3 (i.e. practically the same as a corresponding electrolyte free from MgF_2) and an electrical conductivity of 1.97 to 2.07 $ohm^{-1}.cm^{-1}$ (i.e. lower by 0.16 to 0.14 $ohm^{-1}.cm^{-1}$ than that of an analogous electrolyte free from MgF_2).

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S/136/60/000/04/011/025
E091/E235

Properties of Industrial Aluminium Cell Electrolytes Containing Magnesium Fluoride

of electrolyte samples taken from the vats and shown in Table 2 was determined in the molten state by hydrostatic weighing. No distinct relationship was found to exist between the density of the electrolyte, the cryolite ratio and the MgF_2 content. However, on raising the MgF_2 content, the density usually increases and this increase may precede the decrease in density of the melt by lowering the cryolite ratio. At a certain MgF_2 content, electrolytes with a higher cryolite ratio can have a lower density than electrolytes with a lower cryolite ratio if their MgF_2 content is high (Table 3, Fig 1) In Table 4 the results of specific electrical conductivity measurements are shown for electrolyte samples from DAZ vats working with caustic magnesite additions. Fig 2 shows the relationship between specific electrical conductivity and temperature of electrolytes containing MgF_2. The specific electrical conductivity at 1000°C of electrolytes containing various percentages of MgF_2 is shown in Table 5. The volatility of industrial electro-

Card 2/4 lytes, as well as of synthetic ones, at a constant

S/136/60/000/04/011/025
E091/E235

AUTHORS: Belyayev, A. I., and Zhemchuzhina, Ye. A

TITLE: Properties of Industrial Aluminium Cell Electrolytes Containing Magnesium Fluoride

PERIODICAL: Tsvetnyye metally, 1960, Nr 4, pp 45-48 (USSR)

ABSTRACT: The aim of the investigation was to determine the most important physical and chemical properties of industrial electrolytes containing magnesium fluoride and to make a comparison between the properties of such electrolytes and electrolytes not containing magnesium fluoride. At an aluminium plant working with additions of caustic magnesite, samples of electrolyte were taken from 44 vats approximately 1 hour before operation and their fusibility, density, electrical conductivity and volatility were tested. The cryolite ratio of these electrolytes was 2.2 to 2.73 and the MgF_2 content was 2.56 to 7.6%. The average CaF_2 content was 3.5 to 4%. The fusibility of the above electrolytes is shown in Table 1. The temperature at which MgF_2-free electrolytes crystallise is higher by approximately 30 to 35°C than that of electrolytes containing MgF_2 (see Table 2). The density

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BELYAYEV, A.I.; FIRSANOVA, L.A.

Technological conference of workers in the aluminum industry. Izv.vys.ucheb.zav.; tsvet.met. 3 no.2:166-168 '60. (MIRA 15:4)
(Aluminum industry—Congresses)

SOKOLOV, O.K.; BELYAYEV, A.I.

Aluminum losses and current efficiency in cryolite-alumina melts containing calcium fluorides and magnesium. Izv.vys.ucheb. zav.; tsvet.met. 3 no.2:96-101 '60. (MIRA 15:4)

1. Krasnoyarskiy institut tsvetnykh metallov, kafedra metallurgii legkikh metallov.

(Aluminum--Electrometallurgy)

BELYAYEV, A.I.; ZHEMCHUZHINA, Ye.A.

Effect of pressure on the leaching of Hungarian bauxites. Izv.vys. ucheb.zav.; tsvet.met. 3 no.2:88-95 '60. (MIRA 15:4)

1. Krasnoyarskiy institut tsvetnykh metallov, kafedra metallurgii legkikh metallov.
(Hungary--Bauxites) (Leaching)

Physico-Chemical Properties of Cryolite-Alumina Melts at a Simultaneous Presence in them of Magnesium and Calcium Fluorides

77726
SOV/149-60-1-15/27

density, and wetting of cryolite-alumina melts is more favorable than that of CaF_2, whereas the opposite is true with regard to electrical conductivity. There are 4 figures; 1 table; and 4 Soviet references.

ASSOCIATION: Krasnoyarsk Institute of Nonferrous Metals. Chair of Metallurgy of Light Metals (Krasnoyarskiy institut tsvetnykh metallov. Kafedra metallurgiyi legkikh metallov)

SUBMITTED: May 8, 1959

Card 9/9

Physico-Chemical Properties of Cryolite-Alumina Melts at a Simultaneous Presence in them of Magnesium and Calcium Fluorides

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SOV/149-60-1-15/27

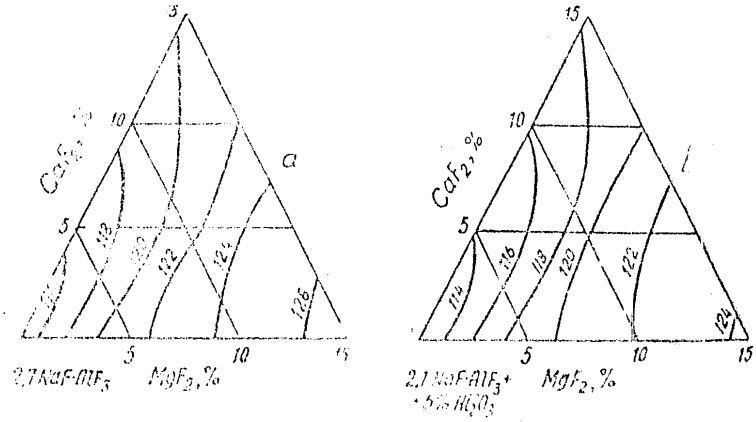

Fig. 4. Isotherms of contact wetting angles at 1.010°C on coal for pseudoternary systems: (a) (I) (b) (II), n = 2.7.

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for (I) at c.n. 2.5 it is 2.37 $ohm^{-1}cm^{-1}$, and at c.n. 2.9. 2.04 $ohm^{-1}cm^{-1}$. For (II) the corresponding figures are 2.29 and 2.43 $ohm^{-1}cm^{-1}$. An addition of 10% CaF_2 changes the latter to 2.12 add 2.32, while an addition of 10% MgF_2 brings them to 2.02 and 2.19 $ohm^{-1}cm^{-1}$. Wetting Angles on Coal. These were measured optically in an argon atmosphere at 1.010°C. They increase when up to 15% Mg and Ca fluorides are added, the action of the former being stronger. Test results are shown in Fig. 4. With increased exposure the wetting angles decrease at a rate which depends on c.n. (the rate is higher at high c.n.) A greater activity of the Mg^{2+} cation as compared to Ca^{2+} cation is due to a smaller ionic radius of the latter and a greater density of its charge. In their conclusions the authors recapitulate the above findings, stating that the action of MgF_2 on meltability,

Physico-Chemical Properties of Cryolite-Alumina Melts at a Simultaneous Presence in them of Magnesium and Calcium Fluorides

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SOV/149-60-1-15/27

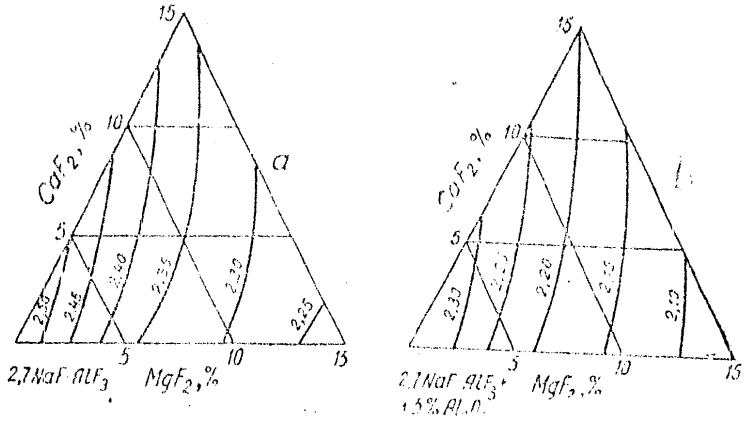

Fig. 3. Isotherms of specific electrical conductivity at 1,000°C for pseudoternary systems: (a) (I) (b) (I), n = 2.7.

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When c.n. is 2.9 or 2.5, the density of (I) at 1,000°C is 2.087 and 2.063 g/cm^3, respectively. The corresponding figures for (II) are 2.068 and 2.044 g/cm^3. The lesser effect of MgF_2 as compared to CaF_2 is due to the strong polarizing action of the Mg^{2+} cation which promotes the formation of voluminous complex ions in the melt, loosening the structure of the latter.

Electrical Conductivity. Ca and Mg fluorides introduced into the melts of pseudoternary systems in a max. quantity of up to 15% lower electrical conductivity, MgF_2 more so than CaF_2. Tests were made with a balanced bridge and ac. The specific conductivity of cryolite was found to be 2.66 ohm^{-1}cm^{-1} at 1,000°C. Test results are shown in Fig. 3. When c.n. is 2.5 or 2.9 , the conductivity maintains its character with the absolute values being lower in the former, and higher in the latter, case. Consequently,

Physico-Chemical Properties of Cryolite-Alumina Melts at a Simultaneous Presence in them of Magnesium and Calcium Fluorides

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SOV/149-60-1-15/27

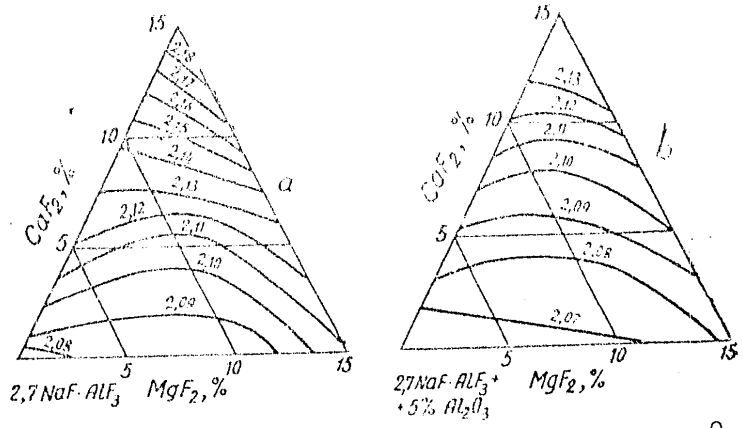

Fig. 2. Isotherms of melt densities at 1,000°C for pseudoternary systems (I) and (II), n = 2.7.

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Physico-Chemical Properties of Cryolite-Alumina Melts at a Simultaneous Presence in them of Magnesium and Calcium Fluorides

Zh. Fiz. Khim., 1960, Vol. 34, No. 1, pp. 15-27
307/149-60-1-15/27

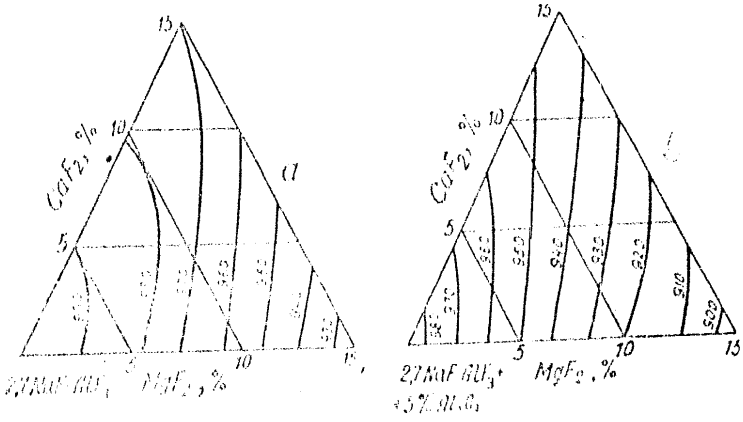

Fig. 1. Meltability diagrams for pseudoternary systems (I) and (II), n = 2.7.

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Physico-Chemical Properties of Cryolite-Alumina Melts at a Simultaneous Presence in them of Magnesium and Calcium Fluorides

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SOV/149-60-1-15/27

melts of (I) and 32 melts of (II) were studied; results are shown in Fig. 1. The crystallization temperature of systems where n was 2.9 was 5°C higher than that of systems with n = 2.7. The authors refer to n as the cryolite number (c.n.). When c.n. is 2.5 and alumina is absent, the crystallization point is 5°C (with alumina, 10°C) lower than that with c.n. 2.7. Density. At c.n. 2.7 and 2.9, addition of fluorides increases the density of melts. At c.n. 2.5, addition of magnesium fluoride (up to 10%) lowers the density of the melt but when 15% mgF_2 and 5-15% CaF_2 are added the density rises. In all these cases MgF_2 increases the density of the melt to a lesser extent than CaF_2.

Tests were made by hydrostatic weighing, using a platinum float of 2.27 cm^3. 19 tests were made with (I) and 13 tests with (II), both with c.n. 2.7. The results are shown in Fig. 2.

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77726
SOV/149-60-1-15/27

AUTHORS: Sokolov, O. K., Belyaev, A. I.

TITLE: Physico,Chemical Properties of Cryolite-Alumina Melts at a Simultaneous Presence in them of Magnesium and Calcium Fluorides

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Tsvetnaya metallurgiya, 1960, Nr 1, pp 108-114 (USSR)

ABSTRACT: A study of physico-chemical properties of pseudo-ternary systems (I) $nNaF \cdot AlF_3$-CaF_2-MgF_2 and (II) ($nNaF \cdot AlF_3$ + 5% by wt Al_2O_3)-CaF_2-MgF_2 is of theoretical as well as practical interest. The study was undertaken from the following points of view: Fusibility. Magnesium and calcium fluorides, introduced in quantities of up to 15% into the above systems, depress the crystallization points in melts, magnesium fluoride to a greater extent than calcium fluoride. The temperature of the beginning of NaF crystallization was determined as 990°. Thirty-one

Card 1/9

Investigation of Effect of Graphite and Salt Additives on Quality of Anode Mass

(TTS)
SOV/149-60-1-15/17

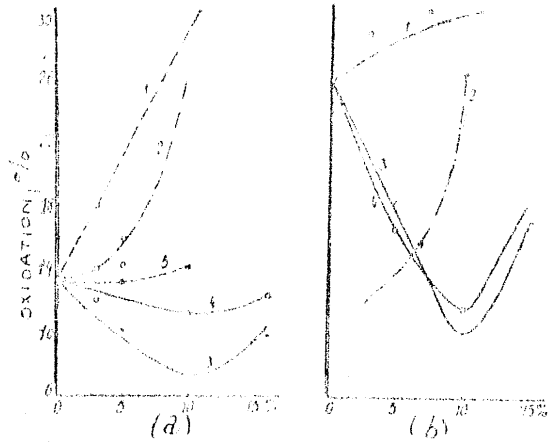

Fig. 4. Oxidation of anode mass prepared from oil coke (a), from a mixture of pitch and petroleum c (b), versus influence of additives: (1) NaCl; (2) + AlF_3; (3) artificial graphite; (4) natural gr (5) $BaCl_2$ + NaCl.

Card 5/6

Investigation of Effect of [illegible] Salt Additives on Quality of Anode [illegible]

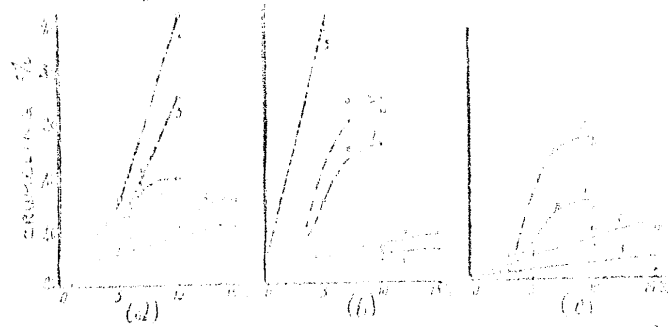

Fig. 3. Crumbling of anode mass prepared from pitch (a) and petroleum (b) coke, as well as from their mixture (c), versus influence of additives: (1) NaCl; (2) NaF + AlF_3; (3) artificial graphite; (4) natural graphite; (5) $BaCl_2$ + NaCl.

Card 5/6

Investigation of Effect of Graphite and Salt Additives on Quality of Anode Mass

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SOV/149-60-1-13/27

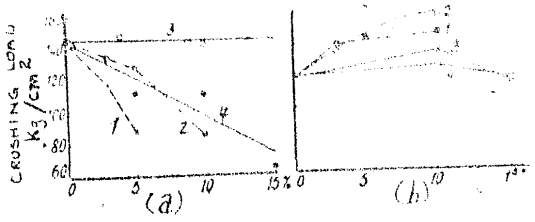

Fig. 2. Mechanical strength of anode mass prepared from petroleum coke (a) a mixture of pitch and petroleum coke, (b) versus influence of additives: (1) NaCl; (2) NaF + AlF_3; (3) artificial graphite; (4) natural graphite.

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Investigation of Effect of Graphite and Salt Additives on Quality of Anode Mass

77724
SOV/149-60-1-13/27

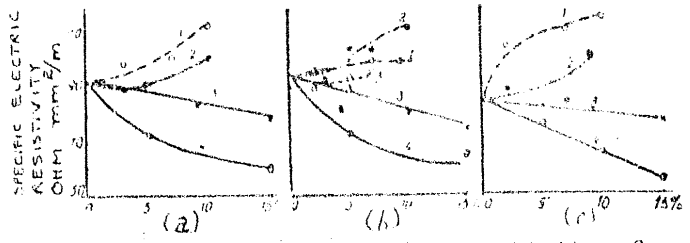

Fig. 1. Specific electric resistivity of anode mass prepared from cokes: pitch (a) petroleum (b) and their mixture (c) versus influence of additives: (1) NaCl; (2) NaF + AlF_3; (3) artificial graphite; (4) natural graphite; (5) $BaCl_2$ + NaCl.

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Investigation of Effect of Graphite and Salt Additives on Quality of Anode Mass

77724
SOV/149-60-1-13/27

crumbling test was carried out by heating specimen to 1,000° for one hour and weighing the crumbled portion. At the same time the oxidation of samples was determined by establishing their weight loss. The authors conclude that for better conductivity and lower oxidation rate, 10% artificial or natural graphite should be added to the dry weight of the anode mass. The collaboration of V. A. Sazhina (senior laboratory assistant) is acknowledged. There are 4 figures.

ASSOCIATION: Krasnoyarsk Institute of Nonferrous Metals. Chair of Metallurgy of Light Metals (Krasnoyarskiy Institut Tsvenykh metallov. Kafedra metallurgiyi legkikh metallov)

SUBMITTED: April 10, 1959

Card 2/6

5.4600, 18.3000

777-4
30V/149-60-1-13/23

AUTHORS: Belyayev, A. I., Zhemchuzhina, Ye. A.

TITLE: Investigation of Effect of Graphite and Salt Additives on Quality of Anode Mass

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Tsvetnaya metallurgiya, 1960, Nr 1, pp 97-100 (USSR)

ABSTRACT: Graphite (natural and artificial), NaCl, $NaF + AlF_3$ (in molar ratio 4:1), and a salt mixture (60% $BaCl_2$ + 40% NaCl) were compounded with coke (coal or petroleum) and binder (pitch), and baked and tested for electrical conductivity, mechanical strength, crumbling, and oxidation. The results are shown in Figs. 1-4. The authors note that the resistivity of anodes at room temperature decreases with salt additions since at room temperatures, these salts are solid. When fused and highly conductive (as during the actual electrolysis) the resistivity will be even lower. The

Card 1/6

BELYAYEV, A.I.

History of aluminum. Trudy Inst. ist. est. i tekh. 20:3-152 '59. (MIRA 12:12)

(Aluminum)

Influence of Aluminium Oxide on Losses and Current Efficiency of Aluminium in Electrolysis of Cryolite-Alumina Melts

of electrolyte) was enclosed in a graphite container in the furnace, and a temperature of 970 ± 10 °C was maintained. The current was constant at 5 amp; cathodic current densities of 1.1 and 0.623 amp/cm^2 were used. The results are shown in Figs 5 and 6 where the current efficiency is plotted against Al_2O_3 content for partly (curves 1 and 3) and fully (curves 2 and 4) dissolved alumina. The efficiency falls under the influence of dissolved alumina and rises in the presence of undissolved particles of alumina, especially in alumina-saturated melts. The authors maintain that the influence of alumina concentration on metal losses and current efficiency can be explained only on the ionic view of the nature of cryolite-alumina melts and complex formation in this system.

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There are 6 figures and 11 references, 6 of which are Soviet, 3 English, 1 French and 1 Italian.

SUBMITTED: 11 June, 1959

Influence of Aluminium Oxide on Losses and Current Efficiency of Aluminium in Electrolysis of Cryolite-Alumina Melts

with increasing alumina content; with lower ratio values the general effect is opposite. With the open container the ratio was varied from 2.2 to 3 and the alumina to 15%, the completeness of solution being checked visually before immersion of the aluminium. The aluminium loss vs Al_2O_3 content curves for various cryolite ratios (Fig 2a) show maxima whose positions depend on the ratio. Fig 2b (loss vs cryolite ratio) shows the favourable effect of undissolved alumina on the loss: with alumina-saturated melts the metal losses are 1/50 of those when the Al_2O_3 content is only 10%, but with excessive contents the losses rise. The experiments to find the influence of alumina on current efficiency were carried out on a laboratory unit (Fig 4) with melts containing 7% MgF_2 + 3% CaF_2 and with various cryolite ratios. To reduce solution of the corundum crucible some of the cryolite-alumina melts were prepared beforehand in a graphite container at 1000 °C and the alumina content was kept > 4%; others were melted directly in the corundum container at 970 °C. The corundum crucible (with 170 g

5.1310

SOV/180-59-5-3/37

AUTHORS: Belyayev, A.I., and Firsanova, L.A. (Moscow)

TITLE: Influence of Aluminium Oxide on Losses and Current Efficiency of Aluminium in Electrolysis of Cryolite-Alumina Melts

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1959, Nr 5, pp 27-34 (USSR)

ABSTRACT: The authors point to the differences in published opinions on the technically important question of the optimum content of alumina for aluminium electrolysis with cryolite-alumina melts. They outline the literature on the nature and properties of such melts and go on to describe their own work to solve this question. The first experiments on aluminium losses were divided into two series with closed and open graphite containers, respectively. The containers were 52 mm outer diameter, 36 inner and 120 high and held 100 g of salt plus oxide. The cryolite ratio was varied in the range 2 - 3, the temperature being kept at 1000 ± 10 °C. Aluminium loss is plotted against cryolite ratio in Fig 1 for alumina-contents up to 10%. The curves show that in general with a cryolite ratio over 2.4 losses rise considerably

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BELYAYEV, A.I.; ZHEMCHUZHINA, Ye.A.

Conference on inorganic chemistry in Bratislava. Izv.vys. ucheb.zav.; tsvet.met. 2 no.6:201-202 '59. (MIRA 13:4)

(Chemistry, Inorganic--Congresses)

BELYAYEV, A.I.

One hundred years of existence of the aluminothermic process.
Izv.vys.ucheb.zav.; tsvet.met. 2 no.6:195-198 '59.
(MIRA 13:4)

1. Krasnoyarskiy institut tsvetnykh metallov, kafedra metallurgii legkikh metallov.
(Aluminothermy)

the political indoctrination, and on the pedagogical methods. Of the 935 students of the faculty, 532 obtain a tuition of 3 to 14 yuans monthly. The size of the tuition depends on financial circumstances of families rather than on the scholastic merits of the students: sons of peasants and workers obtain preferential treatment. The present number of institutions of higher learning in China is 1,290, of which 1,060 were created in 1958.

Setup of Higher Education in the Chinese People's Republic

75405
SOV/149-2-5-31/32

of higher education will be raised to higher standards. One of the most prominent full-time schools is the Northeastern Polytechnical Institute at Shenyang (Mukden). It has the following departments: Ferrous and Nonferrous Metallurgy, Mechanics, Electric and Power Engineering, Mining, Natural Sciences, and Technical Physics. 6,800 students are enrolled. The faculty consists of 690 persons, of which 24 are professors, 21 docents, and 217 teachers. The department of Nonferrous Metallurgy was organized in 1953 and consists of following chairs: dressing of ores, metallurgy of light metals, metallurgy of heavy metals, metallurgy of rare metals, working of nonferrous metals by pressure. There are 932 students in this department; it is equipped with many laboratories; in connection with the studies it is planned to build four plants in 1959: an aluminum plant (electrolytic and electrothermal processes), a magnesium plant (silicothermal process), a zirconium plant, and a uranium plant. The article contains further detailed data on the program of studies, on

Card 2/3

18.0000

75405
SOV/149-2-5-31/32

AUTHOR: Belyayev, A. I.

TITLE: Setup of Higher Education in the Chinese People's Republic

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Tsvetnaya metallurgiya, 1959, Vol 2, Nr 5, pp 188-192 (USSR)

ABSTRACT: The above subject is treated primarily in conjunction with the department of metallurgy of nonferrous metals of the Northeastern Polytechnical Institute. There are three types of institutes of higher education in China: full-time courses consisting of 8 months' studies, 3 month's work, and 1 month's vacation each year; regular institutions of higher education which are associated with industrial plants, the students being workmen of these plants; and evening or correspondence courses. China's aim is to make higher education accesible for everyone, and it hopes to achieve this aim in the course of 15 years. In the next 15 years after this, the level

Card 1/3

small plants were erected in Shenyang (Mukden) and Peking. They were designed for an output of 250 tons per month. Small melting pots are powered by a 3,000 A current. These two plants have done some experimental work trying out new methods of production; production of Fe-Si-Al alloys in a shaft furnace melt with oxygen. These attempts were unsuccessful. The research institute for nonferrous metals in Changsha is investigating the production of magnesium by a silicothermal method. The institute in Shanghai tries a continuous process of titanium reduction by magnesium.

of this plant is equiped with 63 kA melting pots and uses acid electrolytes (cryolite ratio 2.2) and an anode current density of 1 A/cm^2. Magnesium fluoride (5 to 6%) is added to the bath, and the process runs at 920 to 925° with a current efficiency of 89% and a power consumption of 62 g/kwh. The plant carries out very extensive experimental work (addition of sodium chloride, continuous work without elimination of the carbon scum, new designs of melting pots, etc.). The magnesium division chlorinates uncalcined magnesite in shaft furnaces and electrolyzes anhydrous chloride in a four-component bath. The melting pots are powered by the same current (60 kA) as those of the aluminum division. The electrolyte consists of 11% $MgCl_2$, 35-37% $CaCl_2$, 40% NaCl, 10% KCl. The temperature is maintained at 690°, the current density at 0.78 A/cm^2, the current efficiency is 85%, and the power consumption 17 thousand kw-hrs per ton of magnesium. Considering the necessity of simplified methods of aluminum production in people's communes,

aluminum works and the Fushun' aluminum-magnesium plant. The first one is a large modern plant processing diaspore bauxites (58% Al_2O_3, 12 to 16% SiO_2, up to 10% Fe_2O_3). These are sintered with lime and soda. The methods are different from those of the Soviet Union. The features of the Chinese process are: (1) preliminary removal of silicate from the bauxite by leaching the roasted (at 900 to 1,000°) ore with caustic soda (concentration: 100 to 120 g/liter Na_2O) at atmospheric pressure, which permits a removal of 50% of SiO_2 from the bauxite. This means a saving in soda and a greater efficiency of the roasting kilns; (2) use of quick lime instead of limestone, which increases the efficiency of the kilns and yields CO_2 in a 35 to 38% concentration instead of 13 to 14% obtained when bauxite is roasted with limestone; (3) a continuous carbonation of aluminate solutions in paired carbonators. The Fushun' aluminum-magnesium plant uses methods similar to those of the Soviet industry. The aluminum division

18.0000

75403
SOV/149-2-5-29/32

AUTHOR: Belyayev, A. I.

TITLE: Concerning the Metallurgy of Light Metals of the Chinese People's Republic

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Tsvetnaya metallurgiya, 1959, Vol 2, Nr 5, pp 182-186 (USSR)

ABSTRACT: The Chinese People's Republic gives first priority to the development of metallurgy of aluminum and magnesium. The raw material source for these metals is practically unlimited. Large deposits of bauxites exist in Liaoning and Shantung. Alunite and nepheline deposits were also discovered on Chinese territory. High quality magnesites and dolomites were found in the Liaoning province. On the east coast of China where salt is produced by evaporation of sea water, valuable bischofite is a byproduct. During his stay in China, the author became acquainted with the aluminum plants and scientific research institutes where work on light metal metallurgy is carried out. The most important producers are the Shantung

Card 1/4

Surface Activity at Interface Metal/Melt and Energy of Crystal Lattice

75382
SOV/149-2-5-8/32

accordance with Antonov's rule, it was confirmed that the surface activity increases in the following sequence: chlorides, fluorides, oxides. There is 1 table; and 8 Soviet references.

ASSOCIATION: Krasnoyarsk Institute of Nonferrous Metals. Chair of Light Metals Metallurgy (Krasnoyarskiy institut tsvetnykh metallov. Kafedra metallurgii legkikh metallov)

SUBMITTED: February 2, 1959

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TABLE 1 75382 SOV/149-2-5-8/32

Cmpr'son of exp. data on interface tension w/var. calc'd characteristics

Added component / Characteristic	KF	NaF	BaF_2	LiF	CaF_2	MgF_2	AlF_3	BeF_2	KCl	NaCl	LiCl	$BaCl_2$	Al_2O_3
$\Delta\sigma_{me}$	−28	−8	+14	+19	+23	+34	+30	+86	−18	−8	+11	+30	0
$m_c \cdot 10^3$	3,6	4,9	6,7	6,15	9,05	12,3	25,3	28,2	3,6	4,9	6,15	6,7	25,3
U^M	190,4	215,0	547,1	240,1	617,2	688,8	1440,0	826,0	164,4	180,4	193,3	478,3	3618,0
U^b	109,0	123,0	208,5	137,2	235,5	262,0	411,5	315,0	94,1	103,0	110,5	182,0	827,0
U^g	190,4	215,0	273,5	240,1	308,6	344,4	480,0	413,0	164,4	180,4	193,3	239,1	603,0
x	0,93	0,91	0,91	0,90	0,89	0,84	0,77	0,79	0,70	0,65	0,61	0,65	0,6
U_x^M	164,8	177,1	459,0	186,0	494,0	489,0	900,0	515,0	81,0	77,5	77,1	203,5	1398,0
U_x^b	94,25	101,3	175,0	106,3	188,0	186,0	260,0	196,1	46,4	44,4	44,1	77,5	320,0
U_x^g	164,8	177,1	229,5	186,0	247,0	244,3	300,0	257,5	81,0	77,5	77,1	101,7	233,0
V_M	23,4	16,4	37,4	11,3	24,6	21,8	27,1	23,4	37,6	27,0	20,5	52,8	25,5
U^σ	23,3	33,4	38,9	47,8	58,1	70,2	110,0	80,1	14,7	20,0	25,8	26,9	230,0
U_x^σ	20,1	27,5	32,7	37,1	46,5	49,8	69,0	50,0	7,24	8,6	10,3	11,5	88,6

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where V_m is the molecular volume of matter. The authors call U^σ the energy of crystal lattice as referred to a unit of surface area. The experimental methods resulting in the figures of Table 1 are described by the authors in the same journal (Nr 5, 50, 1958). When one cation in the added salt is substituted for another cation, the interface tension rises (while its surface activity decreases) with the rise in U^σ of the added salt. When substances have the same cation, the interface tension decreases (while the surface activity increases) with the rise of the U^σ of the added salt. Antonov's rule ($\sigma_{me} = \sigma_m - \sigma_e$) is not applicable if cations are substituted for other cations, when $\Delta\sigma_e > \Delta w_{me}$ where the latter term is a change in adhesion work among the liquid phases. Conversely, Antonov's rule is applicable if $\Delta\sigma_e < w_{me}$ when anions are substituted for other anions. Both relations are confirmed experimentally. Furthermore, in

bond as per Kapustinskiy's formula ($U^g = U^m/az_c$):

$$U_x^M = 287{,}2\,\frac{z_c z_a x^2}{r_c + r_a}(a+b)\left(1 - \frac{\rho}{r_c + r_a}\right), \qquad (5)$$

where $\rho = 0.345 - 0.00435(r_c + r_a)^2$. Other quantities are as per formula (2). Surface tension is the energy of interaction between the substance apportioned to a unit area of surface, and the phase volumes. Therefore the authors consider it more correct to express the surface activity of compounds as compared to the energy of their crystal lattice, in terms of area units of surface rather than of mass (gram-molecule or gram-equivalent). The energy of crystal lattice proportional to U^σ is calculated according to the formula:

$$U^\sigma\left(U_x^\sigma\right) = \frac{U^M\left(U_x^M\right)}{V_M^{2/3}}, \qquad (6)$$

ion of metal U^b: $U^b = 2U^m/A(a + b)$, where A is Madelung's constant. They also derived the energy of one gram-equivalent: $U^g = U^m/az_c$. The above characteristics were compared to the experimental data given in Table 1, and discrepancies were observed. In the table $\Delta\sigma_{me}$ is the changing interface tension at the boundary of molten aluminum and of a melt of 49% NaF, 39%AlF_3, 12% Al_2O_3 with 5% of different compounds added; m_c is the ion potential("generalized moment") of the cations; U^m is the molar energy of the crystal lattice (Born-Haber); U^b is the one-bond energy of a gram-ion of metal, as computed on the base of U^m (Formula (3)); U^g is the crystal lattice energy of one gram-equivalent. U^m_x, U^b_x and U^g_x are fully analogical to U^m, U^b and U^g, but they are calculated in accordance with the degree of ionic

where e is the electron charge, z is the number of ion charges, and r is its radius. Yesin, O. A., Popel', S. I., compared the surface tension of fused oxides with the energy of the cation-oxygen bond in the melt. Further, they calculated the total molecular energy according to Born-Haber cycle, while the electrostatic part of this energy was calculated according to the formula of Kapustinskiy, A. J.:

$$U_x^m = \left[256(z_c z_a x^2)/(r_c + r_a)\right] \quad (a + b) \qquad (2)$$

where z_c and z_a are valences of the ions; r_c and r_a are their radiuses; a and b are the numbers of cations and anions in an oxide molecule; and x is the degree of the ionic bonding. It appears that even when the degree of co-valent bonding is considerable (x = 0.5), the electrostatic part of the energy is 80 to 90% of the total bonding energy. From the total molar energy U^m the authors derived the energy of one bond of a gram-

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SOV/149-2-5-8/32

AUTHORS: Gerasimov, A. D., Belyayev, A. I.

TITLE: Surface Activity at Interface Metal/Melt and Energy of Crystal Lattice

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Tsvetnaya metallurgiya, 1959, Vol 2, Nr 5, pp 45-49 (USSR)

ABSTRACT: Interface tension is a subject little studied, especially with regard to fused media. A theoretical analysis of surface activity among components in complex systems is difficult; most authors use for this purpose the "generalized moment" as suggested by Semenchenko, V. K. For ions it is:

$$m = \frac{e z}{r}, \qquad (1)$$

Card 1/7

GRAFAS, N.I.; BELYAYEV, A.I.

Some properties of molten salt fluxes and their role in melting and refining aluminum. Izv.vys.ucheb.zav.; tsvet.met. 2 no.4:72-82 '59. (MIRA 13:1)

1. Krasnoyarskiy institut tsvetnykh metallov. Kafedra metallurgii legkikh metallov.
(Aluminum--Metallurgy) (Flux (Metallurgy))
(Chemistry, Metallurgic)

BELYAYEV, A.I.

Pavel Pavlovich Fedot'ev, initiator of nonferrous metallurgy in Russia. Izv. vys. ucheb. zav.; tsvet. met. 2 no.3:135-138 '59.
(MIRA 12:9)

1.Krasnoyarskiy institut tsvetnykh metallov, Kafedra metallurgii legkikh metallov.
(Fedot'ev, Pavel Pavlovich)

CHZHU IAN'-AN [Chu Yen-an]; [redacted], A.I.

Investigating the physicochemical properties of molten Na_3AlF_6 - AlF_3 - Al_2O_3 - LiF and Na_3AlF_6 - AlF_3 - Al_2O_3 - Be_2F_2 for use as aluminum electrolytes. Izv. vys. ucheb. zav.; tsvet. met. 2 no.2:69-79 '59. (MIRA 12:7)

1.Moskovskiy institut tsvetnykh metallov i zolota, Kafedra metallurgii legkikh metallov.
(Aluminum--Electrometallurgy)
(Systems (Chemistry)) (Electrolytes)

FIRSANOVA, L.A.; BELYAYEV, A.I.

Preparing beryllium-aluminum-copper alloys by the reduction of gaseous beryllium chloride. Izv.vys.ucheb.zav.; tsvet.met. 2 no.1: 59-66 '59. (MIRA 12:5)

1. Moskovskiy institut tsvetnykh metallov i zolota. Kafedra metallurgii legkikh metallov.
(Beryllium-aluminum-copper alloys)
(Reduction, Chemical)

Investigation of the Losses of Magnesium in Its Electrolytic Production

fraction falling to the oxidation. The reaction: $Mg+2NaCl=MgCl_2+2Na$ is indicated as a cause of the losses in sodium-chloride melt. The influence of the chlorine settling on the anode was investigated by the blowing through of chlorine. Figure 2 shows that the magnesium loss by the reaction with chlorine is proportional to the current velocity of the chlorine. Figure 3 shows the influence of the cathode potential on the magnesium loss. The terminal voltage was varied between 0.01 and 3.0 v. The maximum loss lies at 0.5 v. This maximum corresponds to the beginning discharge of monovalent Mg^+-ions on the cathode. At 2.8 v, the decomposition voltage of the magnesium chloride, the losses only amounted to 0.12%. There are 3 figures.

ASSOCIATION: Moskovskiy institut tsvetnykh metallov i zolota
(Moscow Institute for Nonferrous Metals and Gold)

SUBMITTED: June 16, 1958

18(4) SOV/163-59-2-11/48

AUTHORS: Zhemchuzhina, Ye. A., Belyayev, A. I.

TITLE: Investigation of the Losses of Magnesium in Its Electrolytic Production (Issledovaniye poter' magniya pri yego elektroliticheskom poluchenii)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 2, pp 61-64 (USSR)

ABSTRACT: As a rule, the yield of magnesium in its electrolytic production is 85%. The loss of 15% is caused by secondary processes. The influences of the following factors are investigated: 1) Reaction between magnesium and electrolyte. 2) Oxidation by atmospheric oxygen on the surface of the electrolyte. 3) Reaction with chlorine, and 4) influence of the applied potential. The reaction between magnesium and the electrolyte and atmospheric oxygen was investigated by placing magnesium rods weighing 5 g into the salt melt. The loss of magnesium in percent by weight was ascertained after 1 hour. By repeating the experiment in argon atmosphere, the fraction of the oxidation by atmospheric oxygen could be determined as a difference. Figure 1 shows the dependence of the magnesium loss on the sodium chloride content of the melt, and the

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The Influence of the Ratio of CaF_2 and MgF_2 to Cryolite on the Solution Rate of γ- and α-Al_2O_3 in Cryolite Melts

curves it is concluded that γ-Al_2O_3 is solved more quickly in melts with higher MgF_2-content (Fig 3). The solution rate of α-Al_2O_3 in melts with different cryolite ratio and changing ratio between MgF_2 and CaF_2 was investigated (Fig 4). The solution rate of α-Al_2O_3 changes only inconsiderably in the case of a change in the cryolite ratio and in the presence of calcium- and magnesium fluorides. The solution rate of γ-Al_2O_3 is higher than that of α-Al_2O_3 in the presence of MgF_2 and CaF_2 in pure $NaF+AlF_2$-melts. There are 5 figures and 6 references, 4 of which are Soviet, 1 English and 1 Hungarian.

ASSOCIATION: Moskovskiy institut tsvetnykh metallov i zolota (Moscow Institute of Nonferrous Metals and Gold)

PRESENTED: July 31, 1958

18·(5)

AUTHORS: Zhemchuzhina, Ye. A., Belyayev, A. I. SOV/163-59-2-10/48

TITLE: The Influence of the Ratio of CaF_2 and MgF_2 to Cryolite on the Solution Rate of γ- and α-Al_2O_3 in Cryolite Melts (Vliyaniye kriolitovogo otnosheniya CaF_2 i MgF_2 na skorost' rastvoreniya γ- i α-Al_2O_3 v kriolitovykh rasplavakh)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 2, pp 56-60 (USSR)

ABSTRACT: The solution rate of γ- and α-Al_2O_3 in pure $NaF+AlF_3$ melts was investigated and the results are given in figure 1. Results show that γ-Al_2O_3 is more quickly solved in the NaF+AlF melt than α-Al_2O_3. The solution rate of γ- as well as of α-Al_2O_3 rises with the increase of the cryolite ratio. The solution rate of γ-Al_2O_3 in melts with different cryolite concentrations and changing ratio between CaF_2 and MgF_2 was investigated and the results are given in figure 2. From the course of the

Card 1/2

Influence of Aluminum Upon the Anodic Effect in the Electrolysis of Kryolithe-Alumina Melts SOV/163-59-1-12/30

density. It is shown that in the region of the electrolyte surrounding the anode there proceed reactions which lead to a destruction of these ions, due to an interaction of the corresponding sub-compounds with CO_2 (which is separated at the anode). There are 3 figures and 3 Soviet references.

ASSOCIATION: Moskovskiy institut tsvetnykh metallov i zolota (Moscow Institute of Non-ferrous Metals and Gold)

SUBMITTED: June 9, 1958

Card 3/3

measured with an amperemeter, but was determined by oscillographs of the anodic effect. The information gained shows that the critical current density greatly increases about 1 minute after the aluminum has been dipped into the melt (corresponding to the time required by the aluminum to melt). If the electrolyte is very acid, this increase is smaller than in less acid or in basic electrolytes. Later on the critical current density decreases again, the decrease proceeding more rapidly in acid electrolytes. Afterwards the critical current density stabilizes at lower values (even below the initial ones) than in less acid or basic electrolytes, in which the critical current density decreases more slowly with time. The maximum in the curves describing the critical current density versus time function (the maximum occurring immediately after charging the metal) is explained as follows: Immediately after charging the metal the aluminum is energetically dissolved, producing surface-active ions Al^+ (in acid melts) or Na_2^+ (in basic melts). They lead to a considerable reduction of the potential between the electrolyte and the carbon anode and hence to an increase of the critical current

18(4)

AUTHORS: Belyayev, A. I., Firsanova, L. A. SOV/163-59-1-12/50

TITLE: Influence of Aluminum Upon the Anodic Effect in the Electrolysis of Kryolithe-Alumina Melts (Vliyaniye alyuminiya na anodnyy effekt pri elektrolize kriolito-glinozemnykh rasplavov)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 1, pp 53-57 (USSR)

ABSTRACT: In previous papers the influence of excess (not dissolved) alumina in the electrolyte (Ref 1) and of the gaseous phase (Ref 2) upon the anodic effect in the electrolysis of kryolithe-alumina melts was investigated. As, however, in industrial aluminum baths the electrolyte is continuously in contact with the molten aluminum, in this paper the influence of the aluminum upon the anodic effect in the electrolysis of kryolithe-alumina melts was investigated according to the usual method of determining the critical current density at the carbon anode (Ref 3). There was only one difference namely that the critical amperage I_{cr} was measured in the presence of the aluminum previously introduced into the electrolyte. In a number of cases, moreover, the critical amperage was not

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KOMPANIYETS, Mariya Fedorovna; YELIZAROV, P.G., inzh., retsenzent; BELYAYEV, A.I., red.; EL'KIND, L.M., red.izd-va; ISLENT'YEVA, P.G., tekhn.red.

[Crystallographical and optical analysis in the aluminum industry] Kristalloopticheskii analiz v aliuminievom proizvodstve. Moskva, Gos.nauchno-tekhn.izd-vo lit-ry po chernoi i tsvetnoi metallurgii, 1959. 179 p. (MIRA 12:6)
(Aluminum--Analysis) (Crystallography)

GRATSERSHTEYN, Izrail' Markovich; BELYAYEV, A.I., doktor tekhn.nauk, prof., retsenzent; YAMPOL'SKIY, Kh.A., red.; PINEGIN, I.I., red.izd-va; MIKHAYLOVA, V.V., tekhn.red.

[Development of the aluminum industry in the U.S.S.R.] Razvitie aliuminievoi promyshlennosti SSSR. Moskva, Gos.nauchno-tekhn. izd-vo lit-ry po chernoi i tsvetnoi metallurgii, 1959. 159 p. (Aluminum industry) (MIRA 12:6)

Monovalent Aluminum (Cont.)

SOV/3171

Ch. VII. Formation of Monovalent Aluminum in Anodic Dissolution (Oxidation) of the Metal in Aqueous Solutions and Fused Salts 125

Ch. VIII. Formation of Subhalides of Aluminum in the Melting of Aluminum With Fused-salt Fluxes 131

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AVAILABLE: Library of Congress (TN775.B347)

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18(4) PHASE I BOOK EXPLOITATION SOV/3171

Belyayev, Anatoliy Ivanovich, and Lidiya Alekseyevna Firsanova

Odnovalentnyy alyuminiy v metallurgicheskikh protsessakh (Monovalent Aluminum in Metallurgical Processes) Moscow, Metallurgizdat, 1959. 142 p. Errata slip inserted. 1,550 copies printed.

Reviewers: B. V. Nekrasov, Corresponding Member, Academy of Sciences, USSR, and G. Ye. Vol'fson, Engineer; Ed. of Publishing House: L. M. El'kind; Tech. Ed.: A. I. Karasev.

PURPOSE: This book is intended for technical personnel in the aluminum industry, personnel at scientific research institutes, and students of schools of higher education.

COVERAGE: The book contains theoretical and experimental material on "subcompounds" (lower-valence compounds) of aluminum and their role in the production of electrolytic and ultrapure aluminum. No personalities are mentioned. There are 98 references: 43 Soviet, 30 English, 22 German, 2 French, and 1 Italian.

Card 1/3

BELYAYEV, A.I.; FIRSANOVA, L.A.

Effect of aluminum on anode effect during electrolysis of cryolite - alumina melts. Zhur. prikl. khim. 31 no.9:1361-1366 S '58. (MIRA 11:10)

(Aluminum--Electrometallurgy)

The Role of Electrolyte Composition in the Intensification of Aluminium Electrolysis Cell Operation

by works' experience (Ref 5). He recalls his previous view (Ref 2) that the presence of cations of elements more electro-positive than sodium can lead to increasing current efficiency by making the discharge of sodium ions less probable, e.g. the work of Rapoport (Ref 6).
There are 5 figures and 6 Soviet references.

ASSOCIATION: Mintsvetmetzoloto

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The Role of Electrolyte Composition in the Intensification of Aluminium Electrolysis Cell Operation

this disqualifies BaF_2 as a possible component, but LiF and BeF_2 would be suitable if available. NaCl and $BaCl_2$ are possibilities but not KF nor KCl because of the effect of potassium on the carbon bottoms of cells. To reduce the resistance of the electrolyte, various additions can be made (Figure 3), of which the authors consider MgF_2 very suitable; not only the direct effect on the conductivity of the melt but also the indirect effect of changing its carbon content through changes in the wetting action (Figure 4) shows the contact angle on carbon for various additions. In increasing the current efficiency, the author considers the reduction of aluminium loss by changing the inter-phase (surface) tension between the molten aluminium and electrolyte. He shows (Figure 5) the influence of various salt additions on this tension and concludes that MgF_2 is suitable for this, as confirmed by

AUTHOR: Belyayev, A.I. SOV/136-58-10-13/27

TITLE: The Role of Electrolyte Composition in the Intensification of Aluminium Electrolysis Cell Operation (Rol' sostava elektrolita v intensifikatsii alyuminiyevykh vann)

PERIODICAL: Tsvetnyye Metally, 1958, Nr 10, pp 61 - 66 (USSR)

ABSTRACT: The possibility of intensifying electrolytic-cell operation in aluminium production by increasing the current strength depends on increasing heat loss, reducing the heating voltage and increasing the current efficiency. An important factor in all of these, the author states, is the composition of the electrolyte. He gives a composite melting point diagram for relevant compounds based on data of various authors. As shown by experience at the Volkhov Aluminium Works (Ref 1), the addition of AlF_3 (which lowers the melting point of the electrolyte and hence the thickness of crusts and thus increases heat losses) is effective. Tests at the Dneprovskiy alyuminiyevyy zavod (Dnepr Aluminium Works) in 1957-1958 showed that MgF_2 is also effecti : with additions of caustic magnesite.

The density of the melt (Figure 2) is another factor and

Card 1/3

sheet achieved by careful polishing of the rolls and by effective cleaning (mechanical and chemical) of the rolled materials; 3) very good surface finish of aluminium and Aldrey (Al-Mg alloy) wire resulting from the application of extruded wire rod; development (still in the experimental stage) of an electrolyte containing boron salts, with the aid of which electrolytic aluminium with electrical conductivity increased by 2-3% can be produced; 5) introduction of the recently developed "Sigma Test" for determination of the electrical conductivity of cast bars with the aid of which faulty material can be detected in the early stages of the manufacturing process; 6) high degree of surface cleanliness of the fine copper wire attained when the finished product is to be enamelled; 7) very good surface finish of tungsten wire achieved by the application of electrolytic polishing.

Hungarian Non-ferrous Metals Industry

The metal yield obtained per current unit is 86 to 87% of the theoretical. Mechanisation is used to a large extent as a result of which the manpower required to produce 1 ton of aluminium has been reduced from 130 to 60-50 man-hours. Pure aluminium is produced by a method based on the Hoopes process, with the cell using 28 000 A at the current density of 0.55 A/cm^2, and the power consumption being 19 000 kWh per ton of 99.99% purity metal. To supply the steadily growing needs of other branches of the Hungarian industry, the metal working industry produces strip, sheet, foil, tubes, wire and a large variety of other wrought and cast forms in aluminium-, copper- and nickel-based alloys. Owing to the wide range of these products fabricated at present in comparatively small quantities, batch production methods are usually employed which result in low overall efficiency and high production costs. As regarding the technological achievement in this field, the following were considered to be worth mentioned: 1) high quality of the copper cathodes (clean and smooth surface); 2) very good surface finish of aluminium and duralumin

Hungarian Non-ferrous Metals Industry

of alumina) attained by efficient utilisation of secondary steam; 2) application of a causticising treatment of the red mud which helped to reduce the consumption of fresh sodium hydroxide to 30-35 kg per 1 ton of alumina; 3) development of a process for electrolytic extraction of gallium from strong alkaline solutions with the aid of a mercury cathode; 4) treatment of the vanadium-bearing residue to produce pure vanadium pentoxide (the residue crystallises out of strong alkaline solution when its temperature is lowered to 45-50 °C); 5) application of aluminium hydroxide instead of paper pulp for filtering aluminate solutions in the Kelly filters. As regards production of primary aluminium, the Hall-Heroult process is used for this purpose. The operating conditions of the reduction cells are different in various plants, the current employed and the current density varying from 28 000 A and 1.1 A/cm^2 at Tatabánya, to 50 000 - 60 000 A, 0.7-0.76 A/cm^2 at Inota. The cryolite ratio of the electrolyte (to which no other additions are introduced) is maintained at 2.5 to 2.7.

SOV/149-58-6-18/19

AUTHORS: Belyayev, A.I. and Perlin, I.L.

TITLE: Hungarian Non-ferrous Metals Industry
(Vengerskaya promyshlennost' tsvetnykh metallov)

PERIODICAL: Izvestiya Vysshikh Uchebnykh Zavedeniy, Tsvetnaya Metallurgiya, 1958, Nr 6, pp 143 - 146 (USSR)

ABSTRACT: The material for this report was collected by the authors during their three weeks' stay in Hungary in July, 1958, when they made an extensive tour of the aluminium-producing plants and factories engaged in working and processing other non-ferrous and rare metals. The Hungarian aluminium industry, based on large deposits of high-grade bauxite ore, has been in existence since 1930, and at present it comprises 5 plants; those at Magyaróvár and Almásfüzitő produce alumina only; both alumina and aluminium are produced at Ajka, while plants situated at Tatabanya and Inota produce aluminium only. Owing to the high quality of the Hungarian bauxite, the Bayer process is used exclusively for the preparation of pure alumina, the following features being listed by the authors as characteristic for the Hungarian practice: 1) low consumption of steam (at present 6 tons of steam per 1 ton

Card1/4

Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium

in industrial electrolytes. As to the electrolytes for refining aluminium, the value of σ_M will increase with decreasing value of the molar ratio NaF/AlF_3 and with the increasing $BaCl_2$ content.

There are 11 figures and 11 references, 9 of which are Soviet and 2 English.

ASSOCIATION: Moskovskiy institut tsvetnykh metallov i zolota.
Kafedra metallurgii legkikh metallov.
(Moscow Institute of Non-ferrous Metals and Gold.
Chair of Metallurgy of Light Metals)

Card 9/9

Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium

can be also increased by additions of LiF, LiCl, $BaCl_2$ and BaF_2, chlorides being more effective than fluorides. Even more effective in this respect is BeF_2. However, if, as has been postulated - the presence of Be^{2+} ions results in the change of the structure of the melt (destruction of AlF_6^{3-} anions with the corresponding increase in the concentration of Al^{3+} ions) introduction of BeF_2 in the electrolyte would not be advisable, particularly in view of the toxicity and stability of beryllium compounds. On the other hand, if the fact that losses of aluminium are slightly higher in the presence of Be^{2+} than in the presence of Ca^{2+} is due to variation of the rate of removal of dissolved aluminium, addition of BeF_2 should result in considerable reduction of losses of aluminium

Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium

electrolytes with a high AlF_3 content the value of σ_M of aluminium decreases very slightly even at high values (2-3 A/cm^2) of the cathodic current density; 6) as regards the problem of the optimum composition of the electrolyte, σ_M of aluminium in contact with the $NaF-AlF_3$ electrolyte does not change much when the molar ratio NaF/AlF_3 varies from 3 to 2.5 but increases rapidly with further increase of the AlF_3 content (Figure 3). However, an increase of the AlF_3 content in acid electrolytes increases the losses of aluminium. Industrial electrolytes most often contain additions of CaF_2 and MgF_2. The results of the present investigation indicate that the beneficial effect of these additions, particularly CaF_2, is more pronounced in alkaline (with a high NaF content) than in acid electrolytes. The value of σ_M

and r - cation radius).

The results of the present investigation can be summarised as follows:

1) depending on the composition of the electrolyte, the value of σ_M of the system aluminium/electrolyte can vary between 330 and 800 dynes/cm;

2) the surface activity of the cations increases with the decreasing value of the generalised moment. The surface activity of the studied anions (Cl^-, F^-, O^{2-}) increases when their generalised moment increases;

3) the surface activity of various additions depends to a large extent on the composition of the electrolyte;

4) "strong" ions affect σ_M by formation of complex ions and by changing the structure of the melt;

5) the slope of the electro-capillary curves (Figure 10) indicates that the surface of aluminium in contact with fused fluorides and chlorides is negatively charged (in the absence of an external field). In the case of fluoride

Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium

current density on σ_M of the system metal/electrolyte is shown in Figure 10: Curve 1 - KCl + NaCl eutectic, 800 °C; Curve 2 - KCl + NaCl eutectic + 1 mol.% AlF_3, 800 °C; Curve 3 - (chiolite + 60% $BaCl_2$)/(70% Al + 30% Cu); 800 °C; Curve 4 - (28.6 mol.% AlF_3 + 71.4 mol.% NaF) + 5% Al_2O_3, 1 000 °C; Curve 5 - Swiss electrolyte/(70% Al + 30% Cu). 800 °C. Finally, Figure 11 shows the effect of 10 mol.% additions of KF, NaF, LiF, BaF_2, CuF_2, MgF_2 and BeF_2 to the electrolyte consisting of 28.6 mol.% AlF_3 and 71.4 mol.% NaF + 5% Al_2O_3 on the quantity of aluminium (g/100 g of melt/hr) lost in the electrolyte (the effect of these additions is correlated with the "strength" of the corresponding cations expressed in terms of a quantity postulated by Semechenko who termed it "generalised moment" of the cation. It is equal to $m = ez/r$, where e - electron charge, z - number of charges in the cation

Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium

shown in Figure 6. Variation of σ_M of the system (70% Al + 30% Cu)/(NaF, AlF_3) + 60% $BaCl_2$ with the varying AlF_3 content is illustrated in Figure 7. The effect of additions of AlF_3, LiF, NaCl and NaF on σ_M of the system (70% Al + 30% Cu)/chiolite + 60% $BaCl_2$ at 800 °C is shown in Figure 8.

The relationship between σ_M of the system Al/electrolyte at 800 °C and the concentration of F^- and Al^{3+} ions is illustrated in Figure 9: Curve 1 - electrolyte : NaCl; F^- replaces Cl^-; Curve 2 - electrolyte : KCl/NaCl eutectic; F^- replace Cl^-; Curve 3 - electrolyte : KCl + NaCl + NaF; concentration of F^- ions remains constant, Al^{3+} replaces Na^+ until all F^- ions are combined with the Al^{3+} ions; Curve 4 - electrolyte : KCl + NaCl + AlF_3 eutectic. The effect of the cathodic

Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium

electrolyte reacting with the metal, the maximum pressure varied during each experiment. The graphs illustrating the variation of σ_M were constructed for the minimum observed values of the maximum pressure.

The effect of the AlF_3 content in an electrolyte consisting of (NaF, AlF_3) + 8 to 10% Al_2O_3 on σ_M at 1 000 °C is shown in Figure 3. The effect of the Al_2O_3 content on σ_M at 900 °C is shown in Figure 4: Curve 1 - electrolyte consisting of 28.6% AlF_3 71.4% NaF (molecules); Curve 2 - chiolite (5 NaF.3AlF_3). The effect of additions of BeF_2, AlF_3, MgF_2, $BaCl_2$, BaF_2, CaF_2, LiF, LiCl, NaCl and KF to an electrolyte consisting of 28.6% AlF_3 and 71.4% NaF (molecules) + 12% Al_2O_3 on σ_M at 1 000 °C is shown in Figure 5. The effect of $BaCl_2$ on σ_M of the system (70% Al + 30% Cu)/chiolite at 800 °C is

Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium

Most of the experiments were carried out by the method of maximum pressure in the metal drop adapted by the authors for fluoride melts, with the aid of apparatus illustrated in Figure 1. The fact that the values of σ_M obtained by this method for several metal/fused salt systems were almost identical with those obtained by Karpachev at al. (Ref 7) proved the suitability of the method for the present purpose. For the determination of the electrocapillary curves (Figure 10), the inverted method of maximum pressure as applied by Romanov (Ref 4) was used. The apparatus is shown schematically in Figure 2. X-ray photography was also used but owing to the small difference between the coefficients of permeability of the metal and electrolyte, the results obtained by this method were not very accurate and could be used only to indicate the order of magnitude of σ_M. The results of the experiments in which the effect of various factors on σ_M was determined are reproduced graphically. Owing to the

SOV/149-58-5-6/18

AUTHORS: Gerasimov, A.D. and Belyayev, A.I.

TITLE: Investigation of the Interfacial Tension at the Metal-electrolyte Boundary During Electrolytic Extraction and Refining of Aluminium (Issledovaniye mezhfaznogo natyazheniya na granitse metalla s elektrolitom pri elektroliticheskom poluchenii i rafinirovanii alyuminiya)

PERIODICAL: Izvestiya Vysshikh Uchebnykh Zavedeniy, Tsvetnaya Metallurgiya, 1958, Nr 5, pp 50 - 61 (USSR)

ABSTRACT: The interfacial tension, σ_M, at the boundary of two immiscible phases is a measure of the difference of their surface energies and in the case of two mutually soluble phases it determines the equilibrium conditions. Its practical importance lies in the fact that it is one of the factors which determine the efficiency (metal yield/ /power consumption) of electrolysis of fused salts. Scarcity of reliable data on the value of σ_M in the system aluminium/alkali fluorides-alumina, prompted the present authors to re-investigate this problem with the view of determining the optimum composition of the electrolyte in the extraction and refining of aluminium.

Cardl/9

Investigation of the Leaching of North Ural Bauxites by Highly Concentrated Caustic Soda Solutions at Atmospheric Pressure

SOV/163-58-4-16/47

from bauxite: the output was 80% at 156° and about 86% at 174°. There are 5 figures, 1 table, and 2 Soviet references.

ASSOCIATION: Moskovskiy institut tsvetnykh metallov i zolota (Moscow Institute of Nonferrous Metals and Gold)

SUBMITTED: January 22, 1958

Card 3/3

~13.8%. The mineralogical composition was determined by means of thermal and X-ray structure analyses. The output of aluminum oxide increases with the rise of temperature and reaches 82% at 450°. The endothermic effect of the dehydration of diaspores (a hydrous aluminum oxide) contained in red mud due to the incomplete decomposition of the bauxite decreases with the rise of temperature. The maximum endothermic effect is observed at 350°, it is much smaller at 400° and disappears completely at 450 and 500°. The endothermic effect of the dehydration of sodium aluminum silicate increases, however, with the rise of temperature (temperature of the interaction between the bauxite and the melted caustic soda). (The sodium aluminum silicate is formed at the leaching of the bauxite.) To investigate the influence of temperature on the leaching of North Ural bauxite at atmospheric pressure, concentrated caustic soda solutions with high boiling points were used. The data obtained show that temperature has an essential influence on the output of the aluminum oxide Al_2O_3

18(4)

AUTHORS: Belyayev, A. I., Zhemchuzhina, Ye. A. SOV/163-58-4-16/47

TITLE: Investigation of the Leaching of North Ural Bauxites by Highly Concentrated Caustic Soda Solutions at Atmospheric Pressure (Issledovaniye vyshchelachivaniya severoural'skikh boksitov vysokokontsentrirovannymi rastvorami yedkogo natra pri atmosfernom davlenii)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1958, Nr 4, pp 94 - 100 (USSR)

ABSTRACT: This investigation concerned the intensification of bauxite leaching by increasing the concentration of the alkaline solution and by increasing the boiling temperature under atmospheric pressure. The investigation also concerned the possibility of decomposing North Ural bauxites by melted caustic soda (with a subsequent leaching of the agglomerate formed by boiling water), as well as decomposition of the same bauxites by concentrated solutions of caustic soda at different temperatures and atmospheric pressure.- The North Ural bauxites investigated had the following composition: 57.6% Al_2O_3, 18.96% Fe_2O_3, 6.24% SiO_2, 2.34% TiO_2, remainder

Card 1/3

Composition Diagram and Properties of the Cryolite Corner in the Systems Na_3AlF_6-Al_2O_3-MgF_2 and Na_3AlF_6-AlF_3-MgF_2

that it decreases in the cryolite corner of the system Na_3AlF_6-Al_2O_3-MgF_2 in direction to Al_2O_3 and MgF_2, this is especially the case in the section at a ratio Al_2O_3 : MgF_2 = = 7 : 3.

In the system Na_3AlF_6-AlF_3-MgF_2 at simultaneously increasing AlF_3 and MgF_2 the specific electric conductivity of the cryolite melt increases.

The solubility of Al_2O_3 decreases in the presence of MgF_2.

There are 9 figures and 5 references, all of which are Soviet.

SUBMITTED: May 3, 1957

Card 2/2

78-3-4-33/38

AUTHORS: Vatslavik, E., Belyayev, A. I.

TITLE: Composition Diagram and Properties of the Cryolite Corner in the Systems Na_3AlF_6-Al_2O_3-MgF_2 and Na_3AlF_6-AlF_3-MgF_2 (Diagrammy sostav - svoystvo kriolitovogo ugla sistem Na_3AlF_6-Al_2O_3-MgF_2 i Na_3AlF_6-AlF_3-MgF_2)

PERIODICAL: Zhurnal Neorganicheskoy Khimii, 1958, Vol. 3, Nr 4, pp. 1044-1047 (USSR)

ABSTRACT: The physico-chemical properties of the melts of the systems Na_3AlF_6-Al_2O_3-MgF_2 and Na_3AlF_6-AlF_3-MgF_2 were investigated in detail.

In the system Na_3AlF_6-Al_2O_3-MgF_2 the fusion diagram of the cryolite corner of the system was constructed. It was found that the density of the melt decreases in direction to Al_2O_3 and increases in direction to MgF_2. In the system Na_3AlF_6-AlF_3-MgF_2 the density of the melt is decreased in direction to AlF_3 and increased in direction to MgF_2. The determinations of the electric conductivity showed

Card 1/2

BELYAYEV, A.I.

Eleventh scientific and technical conference of students at the Moscow Institute of Nonferrous Metals and Gold. Izv.vys. ucheb. zav.;tsvet. met. no.3:151-153 '58. (MIRA 11:11)
(Nonferrous metals) (Moscow--Metallurgical research)

BELYAYEV, A.I.; POL'KIN, S.I.

Higher metallurgical education and research in the United States; from materials of a trip. Izv. vys. ucheb. zav.; tsvet. met. no.2: 176-180 '58. (MIRA 11:8)

(United States--Metallurgical research)
(Metallurgy--Study and teaching)

BELYAYEV, A. I.

Conference on the electrometallurgy of light metals. Izv. vys. ucheb. zav.; tsvet. met. no.1:183 '58. (MIRA 11:6)
(Light metals--Electrometallurgy)

SOV/137-59-1-462

Refining of Aluminum by Distillation in Conjunction With Subhaloid Compounds

In order to improve the purity of refined Al multiple D of the condensate should also be employed.

B L

Card 2/2

SOV/137-59-1-462

Translation from: Referativnyy zhurnal. Metallurgiya, 1959, Nr 1, p 58 (USSR)

AUTHORS: Belyayev, A. I., Firsanova, L. A.

TITLE: Refining of Aluminum by Distillation in Conjunction With Subhaloid Compounds (Rafinirovaniye alyuminiya distillyatsiyey cherez subgaloidnyye soyedineniya)

PERIODICAL: Izv. vyssh. uchebn. zavedeniy. Tsvetn. metallurgiya, 1958, Nr 1, pp 116-120

ABSTRACT: The process of refining of Al by means of distillation (D) in conjunction with subfluoride and subchloride was investigated with the aid of a laboratory vacuum device; the behavior of impurities was studied concurrently. It was found that the behavior of the impurities is identical during D of Al with either subfluoride or subchloride. Si and Fe may be present in the initial Al in significant quantities without passing into the refined metal; Cu, Ti, and Mn pass into the refined metal more readily, where Mg, Zn, and Ca pass into the final metal so easily that their concentration in the initial Al must be kept to a minimum. The purity of refined metal varies from 99.8% Al, during D of Si-Al, to 99.999% Al during D of primary Al

Card 1/2

BELYAYEV, A.I.

Second World Metallurgical Congress in Chicago. Biul TSIIN tsvet. met. no.1:34-35 '58. (MIRA 11:4)
(Chicago--Metallurgy--Congresses)

BELYAYEV, A.I.

LEONIDOV, N.K.

85(5) PHASE I BOOK EXPLOITATION SOV/1497

Akademiya nauk SSSR. Institut nauchnoy i tekhnicheskoy informatsii

Metallurgiya SSSR, 1917-1957, t. 1 (Metallurgy of the USSR, 1917 - 1957, Vol. 1) Moscow, Metallurgizdat, 1958. 745 p. 3,000 copies printed.

Ed. (Title page): I. P. Bardin, Academician; Ed. (Inside book): G. V. Popova; Tech. Ed.: O. G. Bakker.

PURPOSE: The book is intended for scientific workers and engineers in metallurgical plants and in the machine-building industry. It may also be used by students in advanced courses in metallurgical vuses.

COVERAGE: This collection of articles covers extensively practical and theoretical developments in Soviet metallurgy during the last 40 years. The material deals with the discovery and development of the major ore deposits and the growth of the metal industry in various parts of European and Asiatic USSR. Research institutes, laboratories, their location, and the names of the scientists and engineers involved are listed. Many papers contain so many references and names of various personalities that it was considered beyond the scope of the coverage of each article to list them. The authors claim that the processes, methods and theories described in this book reflect the most recent developments in Soviet metallurgy.

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BELYAYEV, A.I.

Metallurgy of the USSR (Cont.) SOV/1497

new method is undergoing tests on a semi-industrial scale in which the roasting is done at high temperature and which results in liquid products of the reaction. There are 47 references, 38 Soviet, and 9 German.

Bilyev, N.F. (Deceased). Metallurgy of Heavy Nonferrous Metals 503
This article gives an outline of the state of art of metallurgy in the USSR from 1913 to 1957. The development stages are presented in chronological order and the location of deposits, metallurgical plants, research institutes are mentioned. Some production figures are given. Some space is devoted to the production of nickel. It is stated that a new and improved method will have to be developed to improve production. The use of the carbonyl method (presumably a variation of the Mond Process) is to be adopted "within the next few years." There are 74 Soviet references.

Belyayev, A.I. The Metallurgy of Aluminum 529
The author lists bauxite and sillimanite deposits in the USSR and the plants and electric power stations used for processing alumina.

Metallurgy of the USSR (Cont.) SOV/1497

Production figures are given. It is planned to use concentrates of sillimanite for the production of aluminum and silumin. Various method of aluminum production are discussed. There are 76Soviet references.

Galyanitskiy, B.S. The Metallurgy of Magnesium 552
Russian geological exploration for magnesium minerals is said to have started only under the Soviet regime. The Verkhne-Kamsk deposits of carnallite are reported to amount to billions of tons. A number of saline lakes are listed as another valuable source of raw material. The bays of the Sea of Azov and of the Caspian Sea are reported to contain enough salts for commercial exploitation. Deposits of dolomite are found in most industrial areas of the USSR. Currently three methods of producing magnesium are used in the USSR: 1) electrolysis 2) reduction of magnesium oxide by ferrosilicon, and 3) reduction of magnesium oxide by carbon. Other methods are under development which will take advantage of local conditions and streamline the production of magnesium. There are 89 Soviet references.

Sazhin, S.F. Development of the Metallurgy of Rare and Minor Metals in USSR 570
Rare metals are classified as follows: 1. Light rare metals Li, Rb, Cs, Be, 2. Rare earths - all lanthanides of Sc, Y, 3. Scattered rare metals Ga, In, Tl, Ge, 4. High temperature rare metals Ti, Zr, Hf, V, Nb, Ta, Mo, W, Re, 5. Radioactive metals Ra and all actinoid elements. Mercury, tin,

Card 15/21

BELYAYEV, A.I., professor.

Important contribution to the utilization of natural resources of our country; combine treatment of nepheline. Priroda 46 no.6:41-42 Je '57. (MLRA 10:7)

1. Moskovskiy institut tsvetnykh metallov i zolota im. M.I. Kalinina.
(Nepheline)

BELYAYEV, A.I.

ZHUKOVSKIY, Ye.I., prof.; BELYAYEV, A.I., prof.; KUZNETSOV, S.I., dots.

Concerning the review of the book by V.A. Mazel' "Alumina production." Tsvet. met. 30 no.11:82 N '57. (MLRA 10:11)

1. Zaveduyushchiy kafedroy "Metallurgiya legkikh metallov" Severo-Kavkazskogo gorno-metallurgicheskogo instituta (for Zhukovskiy). 2. Zaveduyushchiy kafedroy "Metallurgiya legkikh metallov" Moskovskogo instituta tsvetnykh metallov i zolota im. M.I. Kalinina (for Belyayev). 3. Zaveduyushchiy kafedroy "Metallurgiya legkikh metallov" Ural'skogo politekhnicheskogo instituta im. S.M. Kirova (for Kuznetsov).
(Alumina) (Mazel', V.A.)

BELYAYEV, A.I.

NOVIKOV, N.I.; BELYAYEV, A.I.

Investigation of the physical and chemical properties of electrolytes for industrial aluminum electrolyzers. TSvet. met. 30 no.11:46-53 N '57. (MLRA 10:11)

(Aluminum--Electrometallurgy) (Electrolytes)

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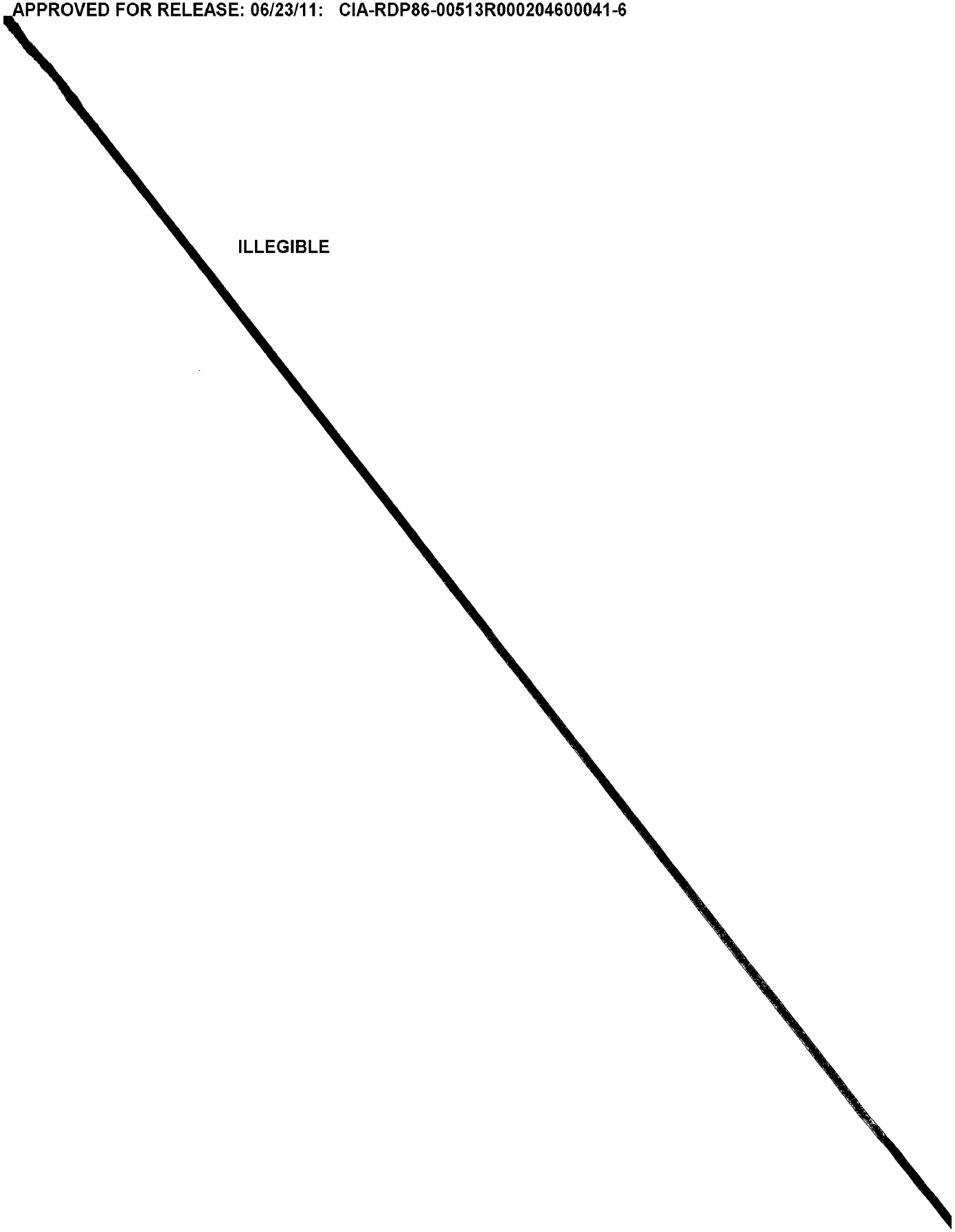

SOV/137-58-9-18739

Investigation of Electrode Processes in Electrolytic Refining of Aluminum

magneto-optical oscilloscope to investigate high-speed electrode processes is recommended. The cathodic and anodic current efficiency of either E is studied. It is found that the current efficiency is 3-4% higher with pure fluoride E, and therefore the latter is more desirable than the chloride-fluoride type. The conclusion is drawn that contamination of the cathode metal by Cu is attributable to the fact that the surface of the anode electrode becomes low in Al, and this creates conditions favorable to Cu going into the melt and being precipitated at the cathode. The study performed confirms the conclusion that the primary cathode process is the discharge of Al^{3+} ions.

N.P.

1. Aluminum--Purification 2. Electrodes--Performance 3. Electrolytes--Properties
4. Electrolytes--Chemical reactions

Card 2/2

SOV/137-58-9-18739

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 84 (USSR)

AUTHORS: Garmata, V.A., Belyayev, A.I.

TITLE: Investigation of Electrode Processes in Electrolytic Refining of Aluminum (Issledovaniye elektrodnykh protsessov pri elektroliticheskom rafinirovanii alyuminiya)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota, 1957, Nr 27, pp 193-214

ABSTRACT: A study is made of the relationship of electrode potentials to current density, temperature, and melt composition in the case of a chloride-fluoride electrolyte (E) (60% $BaCl_2$, 23% AlF_3, 17% NaF) and a pure fluoride E (48% AlF_3, 18% NaF, 18% BaF_2, 16% CaF_2). It is shown that the switching method of determining potentials is not applicable to the study of this process, in view of the comparatively small rate of increase in electrode potentials, varying unevenly with cd when the current is turned on, and also in relation to the rate of drop in electrode potentials which undergoes very great and uneven changes after disconnection of the polarizing current. The use of a

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SOV/137-58-7-14528

An Investigation of the Behavior of Alumina in Aluminum-bath Electrolyte

fluoride salts. Employment of A with elevated γ-Al_2O_3 contents instead of A consisting of α-Al_2O_3 has a negligible effect on reducing the temperature of crystallization of the cryolite melt. All additions of salts to the fused cryolite inhibit A dissolution and reduce the degree of saturation of the electrolyte therewith. A standard for the amount of A to be charged at one time is established, namely, $\leq$ 8% of the amount of fused electrolyte.

L.P.

1. Alumium oxides---Processing 2. Electrolytes--preparation 3. Cryolite ---Properties

Card 2/2

SOV/137-58-7-14528

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 7, p 84 (USSR)

AUTHORS: Marin, K.G., Belyayev, A.I.

TITLE An Investigation of the Behavior of Alumina in Aluminum-bath Electrolyte (Issledovaniye povedeniya glinozema v elektrolite alyuminiyevoy vanny)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota, 1957, Nr 27, pp 178-192

ABSTRACT: A study is made of the effect of the temperature of the calcination process and the addition of mineralizers on the phase composition of alumina (A), and of changes in the hygroscopicity of A, of the fusibility diagram of cryolite and A (α and γ modifications, and technical A) and of the relationship of the solubility of A in cryolite melts to a number of factors. It is established that rapid dissolution of A is possible when it contains 25-35% α-Al_2O_3 and when the grain size is 0.063-0.106 mm. This makes it possible to reduce calcination temperature by 100-150% (or to speed the process) with negligible rise in hygroscopicity. The addition of mineralizers on calcination in rotary ovens is undesirable because of the high consumption of

Card 1/2

BELYAYEV, A.I.

SOV/137-58-8-16634

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 8, p 55 (USSR)

AUTHORS: Vatslavik, E., Belyayev, A.I.

TITLE: An Investigation of Melts of a Cryolite-Alumina-Aluminum Fluoride-Magnesium Fluoride System as Electrolyte for the Aluminum Bath (Issledovaniye rasplavov sistemy kriolit-glinozem-ftoristyy alyuminiy-ftoristyy magniy kak elektrolita alyuminiyevoy vanny)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota, 1957, Nr 27, pp 163-177

ABSTRACT: Investigations of the physicochemical properties of cryolite melts containing MgF_2 (fusibility, density, electrical conductivity, wettability, and critical current density) and determination of Al losses therein result in the conclusion that in terms of its effect on the physicochemical properties of cryolite melts, MgF_2 has significant advantages over CaF_2, rendering desirable its employment as a component of electrolytes for Al baths.

N.P.

Card 1/1 1. Cryolite--Properties 2. Electrolytes--Performance 3. Aluminum--Electrolysis